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ABSTRACT

To study the perceived needs of the rural science teacher a random sampling of rural and non-rural Tennessee teachers (200) responded to a survey which addressed several areas of concern. This paper deals only with questions concerning microcomputer use--the availability of computers for teachers' use, frequency of student computer use, frequency of teacher computer use, and primary purposes for using the computer. Data analysis revealed that computers have had little impact on science education in Tennessee's secondary schools and are being used to only a limited degree; in a large percentage of schools, computers are not being used at all. There did not appear to be any inequities in computer availability between rural and non-rural schools, however, science teachers appeared to be uneasy about fitting computers into their daily routines. In light of the findings in this research, two recommendations are made: the study should be expanded to include findings of the other participating states, and combining of data across the states would result in a large enough pool of computer teachers for effective comparison with noncomputer teachers. It is suggested that science teachers be made aware that computers have the potential to be tools for instruction, providing ways for students to increase problem-solving skills and engage in higher-order learning. Six statistical tables are included. (LL)

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An Analysis of Microcomputer Use Among Tennessee Science Teachers

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There is expressed concern among politicians, educators, and the general public about the quality of education in American schools, specifically the quality and amount of educational technology to which students are exposed. Of particular concern has been the integration of technology into science classrooms and curricula. Additionally, changes in society, in science, and in technology have compelled science educators to rethink what is meant by the term *basic skills* in science.

While there is concern about the perceived general decline in our schools, there is a concomitant theory that rural schools may lag even farther behind urban schools, and that rural students may be suffering to a greater degree. Rural schools comprise most of the nation's schools and rural teachers educate one-third of the country's population (Thurston, McGrath & Stone, 1992). With fewer resources, higher poverty rates, and lower career aspirations among the youth they serve, rural schools face what may be unique problems in implementing technology to improve science teaching and learning.

To identify the problems associated with the improvement of science education in the rural school community, the National Committee for the Study of Options for Rural Science Education was established in 1991 by representatives of 17 states with large rural areas. To study the perceived needs of the rural science teacher, representatives from six states conducted a common survey which addressed several areas of concern, among them specific questions about microcomputer use.

Of the 1,000 surveys sent to a random sampling of Tennessee teachers, 200 responded. No follow up contact was made to non-respondents. Of the respondents, over half were senior high teachers (grades 9-12), with the remaining respondants at the junior high or elementary school levels.

The teachers surveyed were asked to respond to a number of questions covering a broad range of topics related to their science classrooms. However, this paper deals with

only questions concerning computer use. The areas approached in this paper are the availability of computers for the teachers' use, frequency of student computer use, frequency of teacher computer use, and primary purpose for using the computer (See Table 5 at end of paper).

Rural and Non-Rural designations were based on a question concerning the type of school in which the respondants taught. The five options were (1) rural, (2) suburban, (3) urban (small city), (4) urban (large city), and (5) other. Options 2, 3, 4, and 5, were collapsed into the category "Non-Rural." Option 1 made up the "Rural" category.

When responding as to the number of computers available to them, 79.6% of the rural respondants had only 0-2 computers available for classroom or laboratory use, while 74.4% of the non-rural science teachers had 0-2 computers available (see Table 1 at end of paper). Both groups of senior high teachers had only limited access to computers for use in their classrooms.

It was interesting to discover how infrequently computers were used by students in Tennessee science classrooms. When teachers were asked how often their students use the computer, 100% of rural teachers and 94.7% of non-rural teachers claimed that their students used the computer less than weekly (see Table 2 at end of paper). Only 5.3% of the non-rural respondants claimed that their students used computers at least once a week or greater. Weekly computer use by students on the senior high level is very low. Based on the data, there were no rural senior high science students in this sample using the computer weekly, and of all non-rural respondents, only three said that their students used the computer on a weekly basis.

Teacher use of the computer, though relatively low for this "age of information," was greater than that of their students. Over half (53.1%) of the responding rural teachers, and 55.4% of non-rural teachers, said that they used computers personally less than weekly (see Table 3 at end of paper). There was no significant difference in the frequency of rural and non-rural senior high science teachers' personal use of the

computer. The rural and non-rural group of respondents were split evenly between using the computer weekly or greater and using it less than once a week on a personal level.

When asked about their primary purpose for using the computer, a startling 83.3% of rural and 85.7% of non-rural teachers did not use the computer for instruction (see Table 4 at end of paper). On average, only 15.5% of all Tennessee science teachers, rural and non-rural, did use computers for instructional purposes. Although there is no distinct difference in the way rural senior high teachers and non-rural teachers use the computer in the classroom, it is particularly alarming to note that a high percentage of these Tennessee teachers do not use the computer for instruction.

Using a selection of variables within the testing instrument, computer teacher and non-computer teacher designations were assigned to each respondant for an exploratory analysis on practices of computer and non-computer teachers. Because there were so few computer teachers, the following conclusions must be considered only as exploratory trends. When the respondents were into these categories, the following issues were examined: principal teaching assignments; type of school taught; greatest need as a science teacher; and instructional strategies most used. The definition provided in this study for a computer teacher limited the number of respondents who could be counted as computer teachers to only eleven (approximately 10%). This low number of computer teachers argues that computers are not being implemented effectively in science education in Tennessee classrooms. Even the computer teachers in Becker's (1991a) national study spent very little time actually using computers for students' instruction. He found that computers were used only occasionally for a unit during the course of a school year rather than as a routine aspect of the instruction. Although the present study did not investigate the quality of computer use and instruction even to the same extent as in Becker's study, a similar conclusion of little use seems appropriate.

Despite a limited number of respondents who could be counted as computer teachers in this study, the data show some interesting results when comparing computer

teachers to non-computer teachers (See Table 6 at end of paper). For example, computer teachers, overall, use laboratory instruction to teach their students significantly more than non-computer teachers use this method. When comparing the use of other instructional strategies among computer and non-computer teachers, there were no significant differences between the two groups, although there was evidence of a trend that computer teachers were more inclined to utilize small group instruction, where students were required to take responsibility for their own learning, than were non-computer teachers. Computer teachers employed cooperative learning, peer teaching, and individualized strategies more often than did their non-computer counterparts.

For this investigation, the teachers were asked to respond as to their principal teaching assignment from Biology, Chemistry, Earth Science, Physics, or Other. Of the 11 computer teachers, 4 (36.4%) taught Biology, 5 (45.5%) taught Chemistry, and 2 (18.2%) taught Physics. There were no computer using teachers who taught Earth Science or in another field.

When asked to respond as to their greatest need as a science teacher, the most frequent response was "More Money," with 53.8% of non-computer teachers and 18.2% computer teachers stressing this need. The next highest number of responses was a need for "Greater Student/Parent Interest," with 30 (32.3%) non-computer teachers and 4 (36.4%) computer teachers opting for this selection. "Better In Service" yielded 5 (5.4%) responses from non-computer teachers and 1 (9.1%) response from computer teachers. "Administrative Support" garnered 5 (5.4%) responses from non-computer teachers and 2 (18.2%) responses from computer teachers. There were 3 (3.2%) responses from non-computer teachers and 2 (18.2%) responses from computer teachers in the "Other" need category.

The data in this study seemed to imply that computers have had little impact on science education in Tennessee's secondary schools. The most alarming finding of this study is that computers are being utilized to only a small degree in Tennessee secondary

schools. The large percentage of schools where computers are not being used at all is particularly alarming. According to the literature, availability of educational technology is a crucial matter among rural and non-rural schools (Hopkins, 1991). According to the data in this study, there do not appear to be any inequities in computer availability between rural and non-rural schools, even though the number of computers in *all* types of Tennessee schools has been shown to be low. Furthermore, this study does not tell if the teachers' access means being able to schedule the computer lab on occasion, being able to check out a computer on occasion, or actually having a computer in the classroom. The most alarming finding is that no one is using the computer a great deal. In all, only eleven teachers responded that their students used the computer at least once every week. In addition, the little time in which they are being used, it is most often *not* for instructional purposes. This reinforces the literature which charged that any growth in equipment inventories has not significantly improved the integration of computers into our schools (Becker, 1991b).

It is apparent from the data that Tennessee science teachers are uneasy about fitting computers into their daily routines. When asked how often it was a problem, the most recurring response among rural and non-rural teachers was that using the computer for instruction was frequently a problem. What teachers perceive as being most important is critical to any innovative program and the changes it creates. Directly responding to teachers' needs is imperative because if teachers do not accept change, then change will not be evident in classrooms. Only with substantial change in teachers' use of educational technology, will the dream of an educational revolution become a reality.

In light of the findings in this research, there are at least two areas that should be considered for further investigation. First, the study should be expanded to include the findings of the other states that participated in this study. This would give some clarification about whether the responses of the Tennessee teachers were atypical. The fact that the identical survey has been utilized in multiple states will allow a variety of

comparative studies. Second, the combining of data across the states will result in a large enough pool of computer teachers to effectively compare them with non-computer teachers in numerous ways.

Because teachers tend to teach in the same manner as they were taught themselves, this researcher recommends that more emphasis in training faculty to use the computer to deliver instruction should be established at the university level. If using the computer to deliver instruction is modeled in not only teacher education courses, but across the college curriculum, then it follows that those who learn from this method will use it in their own classrooms.

Critics of the educational system have reported that our schools need to improve. Advances in technology have brought about a demand for a "technologically prepared work force" (Hancock & Baugh, 1991). Yet, based on the data in this study, this demand has not changed the use of computers in Tennessee schools. There is a theory that rural schools lag behind non-rural schools in computer implementation, yet these data show that there is no significant difference between these types of schools. The data do show, however, that computer use is slight in all types of Tennessee schools.

The Secretary's Commission on Achieving Necessary Skills (SCANS, 1992) reminds educators that it is not enough to merely expose students to the multimedia of technology available, but to train them to learn *with the aid of* technology. Based on the present study, this sort of learning does not seem to be taking place in Tennessee schools. And based on Becker's (1991a) research, this is a nation-wide trend. The NAEP reported in 1990 that the problems encountered by high school seniors today result from lack of preparation in higher-order thinking skills. Many curricular materials tend to promote rote memorization and recall of isolated facts rather than metacognitive strategies such as problem-solving and transfer. Science teachers should be made aware that computers have the potential to be interactive tools for instruction—ways for students to increase problem-solving skills and higher-order learning. "Science teachers must, by the nature

of their profession, be equipment oriented. Just as optical instruments extend the visual abilities of users, the microcomputer can be used to extend mental capabilities" (Mandall, 1991, p. 6). If society demands advanced technological skills from its members, then it follows that the computer be used in classrooms to improve students' capabilities and increase opportunities for advancement after graduation.

Table 1. Number of Computers Available for Classroom or Laboratory Use

	School Type	
Response Category	Rural	Non Rural
0-2	39 (79.6%)	43 (74.4%)
3 or More	10 (20.4%)	14 (24.5%)

Table 2. Frequency of Student Computer Use

	School Type	
Response Category	Rural	Non Rural
<Weekly	49 (100%)	54 (94.7%)
≥Weekly	0 (0.0%)	3 (5.3%)

Table 3. Frequency of Teacher Computer Use

	School Type	
Response Category	Rural	Non Rural
<Weekly	26 (53.1%)	31 (55.4%)
≥Weekly	23 (46.9%)	25 (44.6%)

Table 4. Primary Purpose for Teachers' Use of the Computer

	School Type	
Response Category	Rural	Non Rural
Non-Instruction	40 (80.3%)	49 (85.7%)
Instruction	8 (16.7%)	8 (14.3%)

Table 5. Senior High Frequencies

Question	Response Category	Rural Frequency	Non-Rural Frequency	χ^2	*df*	*p*
Availability	0-2	39	43	.077	1	.782
	3 or More	10	14			
Frequency of Student Use	< Weekly	49	54	1.085	1	.298
	≥ Weekly	0	3			
Frequency of Teacher Use	< Weekly	26	31	.002	1	.969
	≥ Weekly	23	25			
Primary Purpose	Instruction	8	8	.010	1	.919
	Non-Instruction	40	49			
Problem Using Computer	Infrequently	17	17	.070	1	.791
	Frequently	32	39			

Table 6. Computer Teacher/Non-Computer Teachers' Response Patterns Concerning the Use of Instructional Strategies

Instructional Strategy	Response Category	Computer Teacher	Non-Computer Teacher	χ^2	*df*	*p*
Laboratory	< 2/month	0 (0.0%)	44 (47.3%)	7.187	1	.007**
	≥ 2/month	11 (100%)	49 (52.7%)			
Field Trips	< 2/month	11 (100%)	92 (98.8%)	0.000	1	1.000
	≥ 2/month	0 (0.0%)	1 (1.1%)			
Peer Teaching	< 2/month	7 (63.6%)	80 (86.0%)	2.153	1	.142
	≥ 2/month	4 (36.4%)	13 (14.0%)			
Cooperative Learning	< 2/month	4 (36.4%)	61 (65.6%)	2.447	1	.118
	≥ 2/month	7 (63.6%)	32 (34.4%)			
Demonstration	< 2/month	3 (27.3%)	28 (30.1%)	0.000	1	1.000
	≥ 2/month	8 (72.7%)	65 (69.9%)			
Lecture	< 2/month	1 (9.1%)	2 (2.2%)	0.121	1	.728
	≥ 2/month	10 (90.9%)	91 (97.8%)			
Inquiry Teaching	< 2/month	3 (27.3%)	31 33.3%)	0.004	1	.948
	≥ 2/month	8 (72.7%)	62 (66.7%)			
Individualized Strategies	< 2/month	5 (45.5%)	61 (65.6%)	0.961	1	.327
	≥ 2/month	6 (54.5%)	32 (34.4%)			

**$p < 0.01$

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